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(71) Applicant: Thomas & Betts International, Inc.
Sparks, Nevada 89431 (US)

(72) Inventors:
- Strange, Andrew H.
North Attleboro, Massachusetts 02760 (US)
- Millay, Arthur
Sellersville, Pennsylvania 18960 (US)
- Buchoff, Leonard S.
Huntingdon Valley, Pennsylvania 19006 (US)
- Macinnes, Steven K.
Perkasie, Pennsylvania 18944 (US)
- Rassler, Daniel W.
Hatboro, Pennsylvania 19040 (US)

(74) Representative: Howick, Nicholas Keith
CARPMAELS & RANSFORD
43 Bloomsbury Square
London WC1A 2RA (GB)

(54) Woven mesh interconnect

(57) An electrical interconnect (10) is comprised of a woven mesh in which an array of parallel wires (20) is retained in spaced relation by a transverse array of non-conducting strands (30), the mesh being enclosed or encased within a resilient matrix. The conductive wires are on a close pitch to yield greater current carrying capacity and achieve a lower more stable resistance. With this construction a great number of wires are in contact with each contact pad to yield greater current carrying capacity and corresponding lower resistance. The closer pitch wires also provide greater redundancy of contact points. This structure can be custom configured in as many layers or in a variety of shapes as is desirable to achieve a given electrical performance. The woven mesh can be wrapped around a shaped substrate to provide electrical connections in a desired shape. The woven mesh interconnect can be integrated as part of a boot, wherein the boot receives an electrical device therein and the woven mesh interconnect provides electrical connection from the device within the boot to outside the boot. The woven mesh interconnect can be layered and shaped to form an interconnect which not only provides electrical interconnection but also provides a biasing force due to the shape of the device.

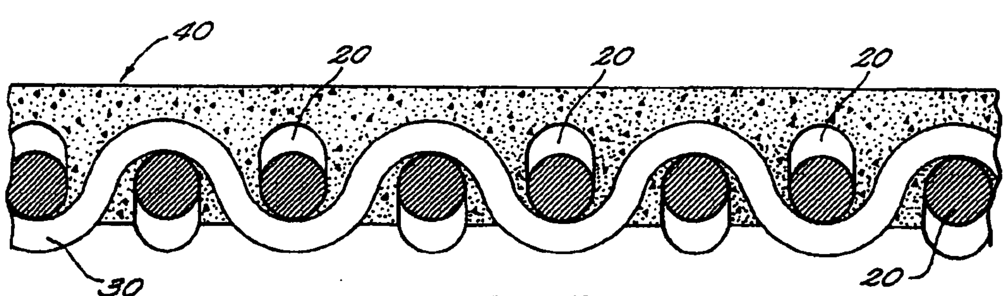


FIG. 1B

EP 0 901 191 A2

DETAILED DESCRIPTION OF THE INVENTION

[0007] An electrical interconnect is comprised of a woven mesh in which an array of parallel wires is retained in spaced relation by a transverse array of nonconducting strands, the mesh being enclosed or encased within a resilient matrix. The structures described herein are of non-adhesive construction; that is, the wires are directly imbedded within the elastomeric matrix.

[0008] Referring to Figs. 1A and 1B, a woven mesh 10 is shown. The woven mesh 10 comprises a first array of conductive wires 20 which are generally parallel with each other. The woven mesh further includes a second array of strands 30 which are nonconductive and are generally parallel with each other. The first array of conductive wires is disposed generally transverse with respect to the second array of strands, and are interwoven with the second array of strands. As shown in more detail in Fig. 1B, a single strand from the second array of strands is disposed such that the strand 30 weaves below one conductive wire 20 of the first array of wires, and then weaves above the adjacent wire of the array. The strand thus alternates being disposed above and below adjacent wires of the first array. A next strand of the array also alternates between being disposed above and below adjacent wires, but in an opposite position as an adjacent strand. For example, a first strand may be above a first wire, below a second wire, above a third wire etc., while an adjacent strand would be below the first wire, above the second wire, below the third wire, etc. Likewise, the wires 20 weave below and above the strands 30 and alternate weaving in an opposite position as an adjacent wire. Accordingly, the two arrays are interlaced and interwoven within each other forming the woven mesh. In addition, alternate weaving variations can be used, such as, weaving between every two wires and strands, every three wires and strands, etc. and any combination thereof.

[0009] The wires 20 are comprised of any conductive material and preferably of nickel, and most preferably of gold plated nickel. The strands 30 are comprised of a non-conductive material and preferably of polyester. The densities of wires and strands could be any density that forms a mesh, but most particularly about 300 wires per inch for the first array of wires and approximately 80 strands per inch for the second array of strands. In a preferred embodiment the wires and the strands each have a respective diameter of approximately 0.04 mm.

[0010] The woven mesh interconnect 50 further includes a matrix 40 for maintaining the spaced relation of the array of wires 20 with respect to each other and with respect to the interwoven array of strands 30. The matrix 40 is nonconductive and typically comprises a resilient material such as silicone rubber. In one embodiment, the matrix 40 encloses the woven mesh 10, with the end surfaces of the matrix having the ends of the first array of wires exposed such that an electrical and mechanical interconnect can be provided from a first end of the woven mesh interconnect 50 to an opposite end of the woven mesh interconnect 50. Two or more rows of mesh 10 can be provided within the same matrix to achieve greater redundancy of contacts.

[0011] In another embodiment of the invention, the woven mesh interconnect 50 provides electrical conduction along an entire side of the elastomeric matrix. For example, the matrix 40, as shown in Fig. 1B allows the wires 20 to protrude through one side of the elastomeric material 40, whereby electrical contact is made along the entire side of the matrix 40 by contacting the protruding portions of the weaving wires 20, which extend through the elastomeric matrix 40. This embodiment is well suited for making 90° connections and where a wrap around connection is desired. In this embodiment, the wires 20 can be exposed at the ends or encased within the elastomeric material.

[0012] Referring now to Fig. 2, a multilayered sheet 100 of woven mesh interconnect is shown. The multilayered sheet 100 includes three layers 51, 52, and 53 of woven mesh interconnect 50. All three layers are oriented similarly in that the array of wires of the woven mesh 10 in each layer is positioned in the same direction. While three layers are shown, it should be appreciated that any number of layers could be utilized. The sheets or webs can then be cut to intended sizes for use. Further, while the layers here are shown aligned such that the array of wires are running in the same direction on each sheet, it should be appreciated that the layers could be alternating in their alignment such that a first layer is oriented with the array of wires running in a first direction and a second layer is oriented with the array of wires running in a transverse direction with respect to the array of wires of the first layer. With such an arrangement, electrical connections are provided from a first horizontal edge of the sheet 100 to a second horizontal edge, and from a first vertical edge to a second vertical edge, while the connections of the vertical edge are isolated from the connections of the horizontal edge.

[0013] Referring now to Figs. 3A-3C, a rectangular shaped woven mesh interconnect 90 is shown. In this embodiment, the woven mesh interconnect comprises a single layer of woven mesh 50, laminated on each side by a nonconductive layer of material 60. In this embodiment, and as shown in Fig. 3B and in greater detail in Fig. 3C, the woven mesh is oriented such that the array of wires 20 extend from a first horizontal or top side 91 to the opposing horizontal or bottom side 92. Further, the woven mesh in this instance comprises two arrays of conductive wires 20 within the same matrix.

[0014] As shown in Figs. 4A-4C, an interconnect 200 is shown in which two separate rows of conductive mesh 220 are used in a sheet, and additional rows may be used to suit particular contact requirements. The conductive wires are on a close pitch to yield greater current carrying capacity and achieve a lower more stable resistance. The closer pitch wires provide greater redun-

said strands of said second array of strands weave around at least two wires of said first array of wires.

5. The woven mesh interconnect of any one of claims 1 to 4 wherein said first end and said second end of each wire of said first array of wires are not covered by said resilient matrix and are exposed for contact with a mating surface.

6. The woven mesh interconnect of any one of claims 1 to 5 wherein portions of said wires of said first array of wires protrude through said first side of said resilient matrix as said wires weave around said strands of said second array of strands.

7. The woven mesh interconnect of any one of claims 1 to 6 further comprising a third array of conductive wires, each wire of said third array having a first end and a second end, said third array of wires disposed parallel with said first array of wires, said second array of strands maintaining said third array of wires in a spaced relation, and wherein said matrix also encloses said third array and wherein said first and second ends of each wire of said third array are not covered by said resilient matrix.

8. The woven mesh interconnect of any one of claims 1 to 7 wherein said woven mesh interconnect is fabricated as a sheet of material and wherein said first array of wires extend from a first edge of said sheet to an opposing edge of said sheet.

9. The woven mesh interconnect of any one of claims 1 to 8 wherein said first array of conductive wires comprises nickel.

10. The woven mesh interconnect of any one of claims 1 to 8 wherein said first array of conductive wires comprise gold-plated material.

11. The woven mesh interconnect of any one of claims 1 to 10 wherein said second array of nonconductive strands comprises polyester.

12. The woven mesh interconnect of any one of claims 1 to 10 wherein said resilient matrix comprises silicone rubber.

13. The woven mesh interconnect of any one of claims 1 to 12 wherein said first array of conductive wires has a density of approximately 300 wires per inch.

14. The woven mesh interconnect of any one of claims 1 to 13 wherein said second array of nonconductive strands has a density of approximately 80 strands per inch.

15. The woven mesh interconnect of any one of claims 1 to 14 wherein said wires of said first array of wires have a diameter of approximately 0.04mm.

16. The woven mesh interconnect of any one of claims 1 to 15 wherein said strands of said second array of strands have a diameter of approximately 0.04mm.

17. The woven mesh interconnect of any one of claims 1 to 16 further comprising a substrate, wherein at least a portion of said resilient matrix is bonded to said substrate.

18. A woven mesh interconnect comprising:

a first layer comprising:
a first array of conductive wires, each wire of said first array of wires having a first end and a second end;
a first array of nonconductive strands disposed transverse with said first array of wires, said first array of strands maintaining said first array of wires in a spaced relation; and
a first resilient matrix encasing said first array of conductive wires and said first array of nonconductive strands, and wherein said first end and said second end of each wire of said first array of wires are not covered by said first resilient matrix; and
a second layer laminated to said first layer, said second layer comprising:
a second array of conductive wires, each wire of said second array of wires having a first end and a second end;
a second array of nonconductive strands disposed transverse with said second array of wires, said second array of strands maintaining said second array of wires in a spaced relation; and
a second resilient matrix encasing said second array of conductive wires and said second array of nonconductive strands, and wherein said first end and said second end of each wire of said second array of wires are not covered by said second resilient matrix.

19. The woven mesh interconnect of claim 18 wherein said first layer is oriented in a similar direction as said second layer.

20. The woven mesh interconnect of claim 18 wherein said first layer is oriented in a transverse direction as said second layer.

21. The woven mesh interconnect of claim 18 wherein said interconnect is formed having a multi-lobe shape, and wherein said first array of wires extend from a first lobe of said multi-lobe shape to a second

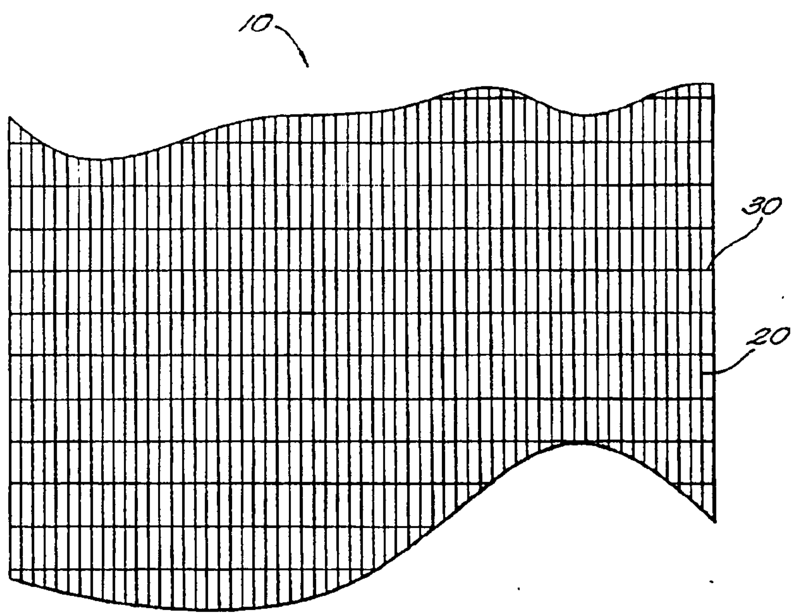


FIG. 1A

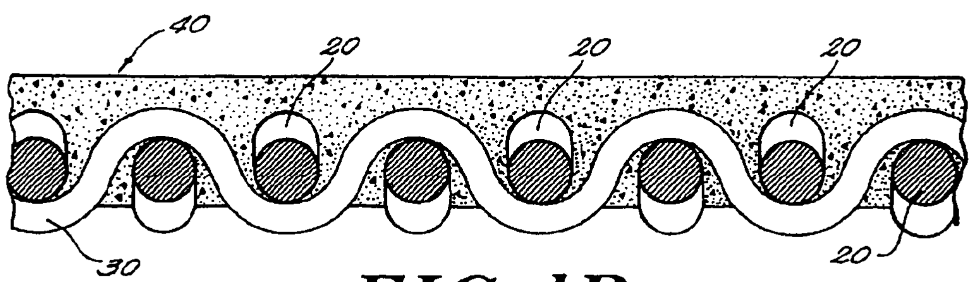


FIG. 1B

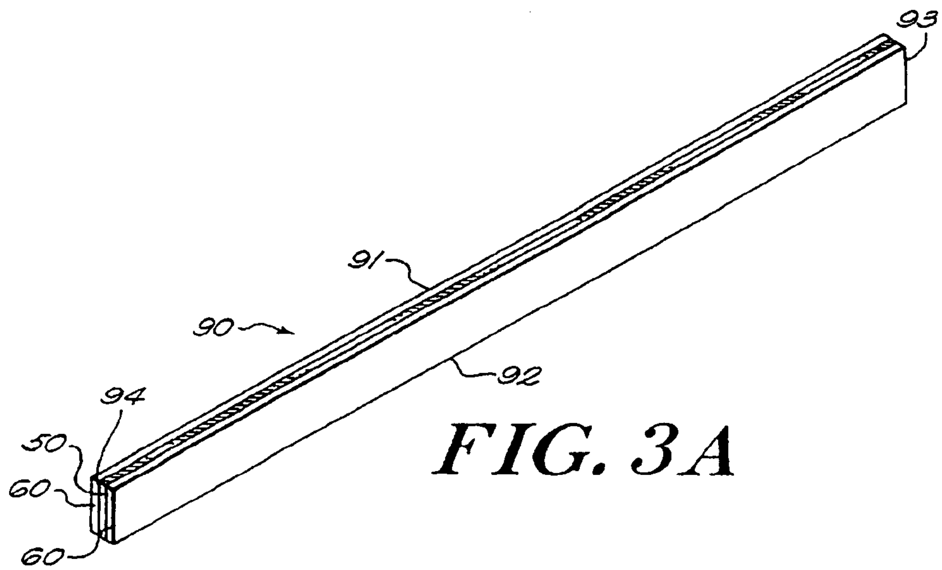


FIG. 3A

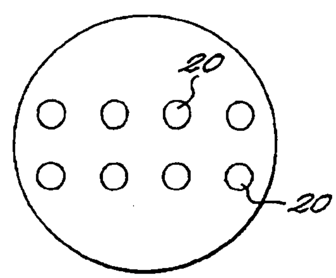


FIG. 3C

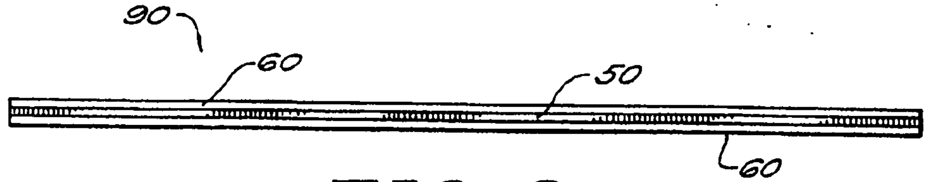


FIG. 3B

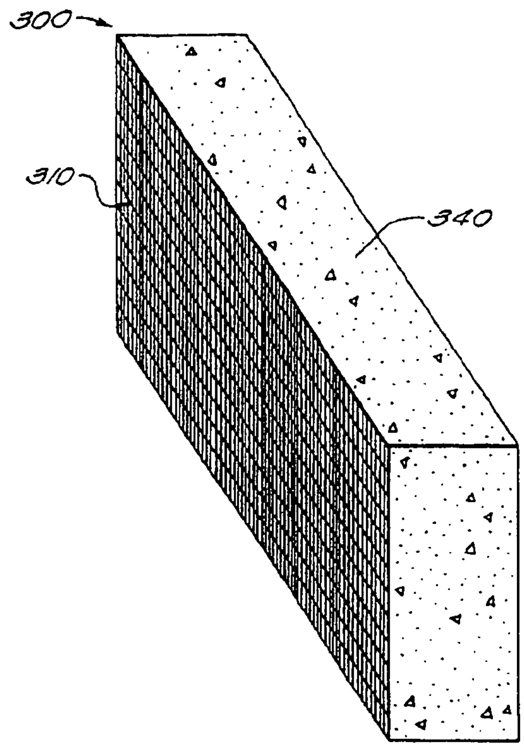


FIG. 5A

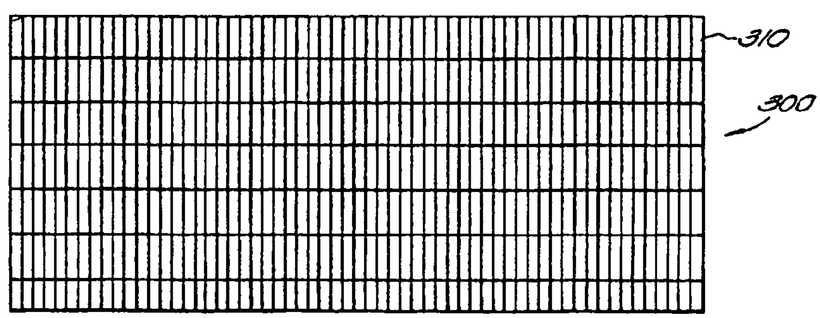


FIG. 5B

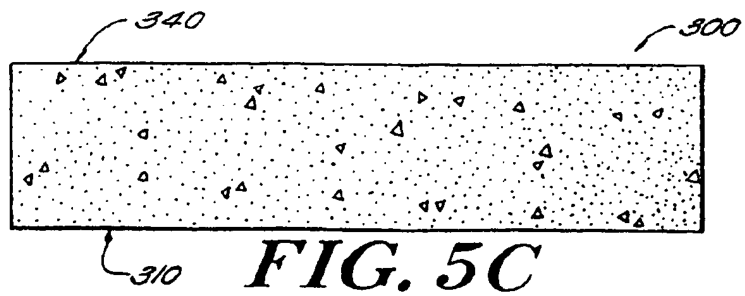
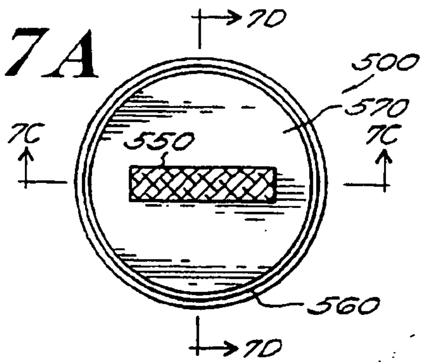


FIG. 5C

FIG. 7A



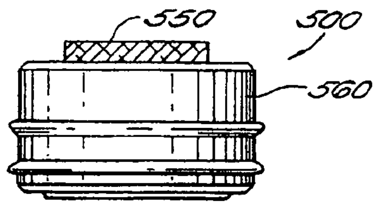


FIG. 7B

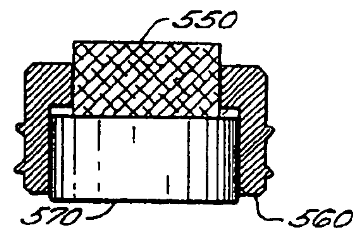


FIG. 7C

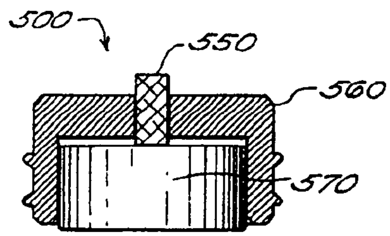


FIG. 7D

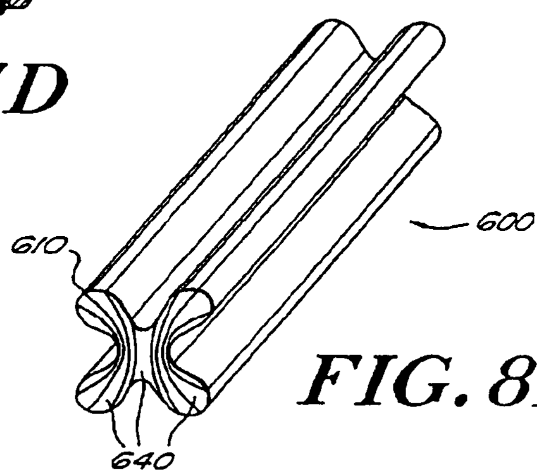


FIG. 8A

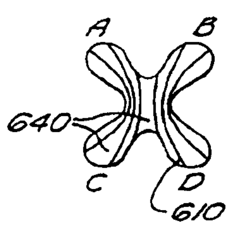


FIG. 8A

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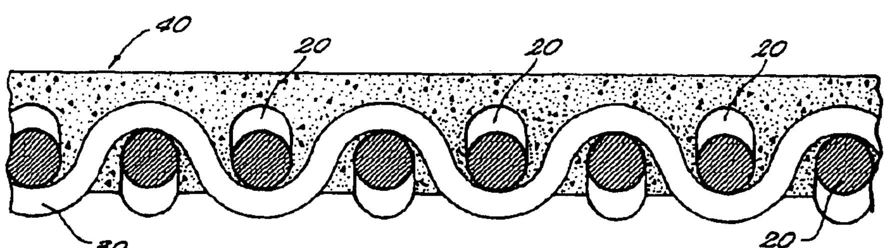

FIG. 1B

EP 0 901 191 A3

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 98 30 7198

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